

It's Election Time.

see inside

THE CANNON

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University of Toronto Engineering Society

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Microcomputers aren't as complicated as they seem: Part 2

The Building Blocks

Every engineer is likely to run into microcomputers sooner or later. This series is intended to help the non-specialist understand what they can do and how to use them.

by Eric Hartwell
Steel Breeze Systems

In the first part of this series we looked at how easy it is to build microcomputer systems from a building-block viewpoint. Naturally, a large part of the design is figuring out which functional blocks you need in the first place. We'll take a stab at that next issue, but first we have to take a closer look at the blocks actually available.

Each microprocessor also has a line of peripheral components for building systems with it. Since one timer, for example, performs much the same function as any other, the differences are in such details as fabrication and optional features. These differences, not the trade name, must form the basis of choosing parts for an optimal design; you're by no means bound to only one set of parts.

Peripheral IC's come with varying degrees of 'inteligence'

'ce', ranging from utterly 'stupid' input/output latches only capable of holding eight bits of data, to complete microcomputers which act as 'slaves' to the main processor. Generally, the more intelligence the better, since it relieves the system (and the designer) from much of the detailed and repetitive work common to many systems.

An excellent example is Intel's 8279 programmable Keyboard and Display Interface (KDI). Since at some point most machines are used by people, the keyboard input and display output function crops up in a lot of microcomputer applications. Why should the system designer have to learn how a group of keys is scanned to see which are pressed, or how a bank of LED's is refreshed, when you can buy a KDI and let it do all the work?

Figure 1 shows a typical application of the KDI. The hardware design is reduced to plugging in the part and hooking up the keys and LED's according to the 'Typical Applications' section of the data sheet. Even better, the programming is pared down to passing basic "this key was just

pressed" and "display this" messages.

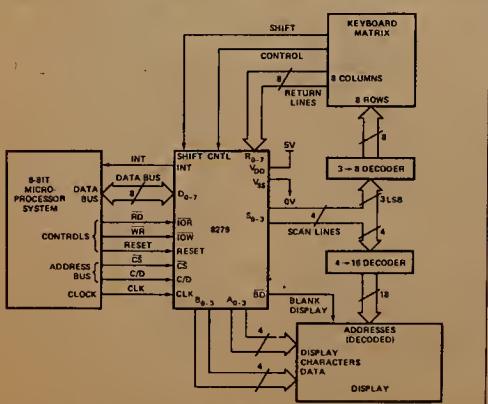
As it happens, the 8279 is actually a special case. It's a complete microcomputer, pre-programmed as a keyboard/display controller at the factory. The same sort of controller is also available in user programmable form. Intel's version is called the 8741 Universal Peripheral Interface (UPI), and Motorola's the 68701 (which can also operate as a stand-alone system). Like the 8748 single chip computer shown in last week's issue, the UPI comes with a processor, memory, timer, and input/output lines forming a complete and autonomous microcomputer. The added bonus is a set of data and control lines that make it look like a simple peripheral to the system.

It may seem odd to use microcomputers as parts of a microcomputer system, but chopping the problem up into a series of independent functional blocks simplifies it much the same way as subroutines do for computer programs. Using a UPI you can actually create your own peripherals if you can't find a part to fit a particular slot in your block diagram.

Naturally, it's cheaper and less effort to use off-the-shelf parts if you can. Most peripherals are reasonably intelligent and can be programmed to tailor their functions to various applications. For example, a timer can be programmed to count pulses or clock continuously, and to stop at the end of an interval or recycle and keep going.

Next issue we'll list some of the peripherals available for the common microprocessor families according to function and part number. Integrated circuits are identified by arbitrary part numbers which seem to follow no pattern or reason. Each manufacturer prefers to use his own numbering system. After a while

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Keyboard and display system using the 8279 (Intel).



Professor Burgess at last year's festivities

W.H. Burgess Day

William H. Burgess, assistant Professor at the University of Toronto, where he became full Professor in 1968. Professor Burgess has published several papers and supervised many students, however teaching is his greatest passion. "It is so difficult for me to say just one thing," said W.H. Graydon, former Chemical Engineering Department Head, when asked to comment on Professor Burgess, "I'm so fond of the man, he's such a good friend."

Professor Burgess is one of the university's most beloved professors. He is a concerned and dedicated humanitarian, and it is for these reasons that he is being honoured.

Professor Burgess was born on March 13, 1924 in Boston, Massachusetts. He graduated in Chemical Engineering in 1949 at Cornell University, where he proceeded to earn his Master's and Doctorate degrees. In 1954, he was appointed

an undeniably great success. The response from students and professors was so tremendous, a second Burgess Day was planned. Next year, a campaign is being planned to make W.H. Burgess Day a national holiday.

ENGINEERING SOCIETY

LEGRESLEY TICKET

On March 6 & 7... VOTE for EXPERIENCE and SKULE SPIRIT. The Engineering Society is YOUR Society and the better it is organized, the better your year will be... at least socially! My name is David LeGresley and for the upcoming elections I have assembled a 'ticket' that offers you EXPERIENCE, SKULE SPIRIT and ORGANIZATION. Everyone on the ticket has been involved in engineering activities, 4 of us have at least one year Engineering Society experience and 3 of us are members of the Engineering Society Executive. With this experience we will be able to run even bigger and better events next year.

This ticket firmly believes that because engineers work hard, they should also play hard, and thus there are several items that we would like to institute for next year. One of these would be a bi-weekly Engineering or Engineering-Nursing Pub. I have talked with members of the Nursing Council about this and they have been very responsive, like nurses usually are! Another area of improvement lies with the BFC. Our treasurer has looked over the books, and with next years fee increase we would like to raise the BFC budget so that they can once again exist... I mean not exist, as they have in the past.

Please read the following introductions carefully because with 37 classes to go to in 3 days, it is unlikely that the complete ticket will be able to visit every class:

PRESIDENT - DAVE LEGRESLEY

In order to have an organized student body the president of the Engineering Society must

be someone who has experience with both Eng Soc activities and Eng Soc administration. I am running for president because I have the experience necessary to perform the job properly.

As this year's V.P. Activities I am responsible for overseeing all "cultural, technical, educational, athletic and social activities" of the Society. Orientation, Oktoberfest, the RESSA Conference, Chariot Race and the Cannonball are just a few of our very successful events this year. It requires a little tact and a lot of cooperation with the club and committee chairmen in order to get such smooth-running events.

In addition to my experience in organizing activities, I also have an excellent knowledge of the Society's administrative dealings. I have been a member of both the Eng Soc Council and the Eng Soc Executive, and I also have experience chairing the Executive Council meetings as well. Due to the tremendous 'participation' in some of the activities this year, I have also developed a knack at dealing with the University's administration (i.e. Physical Plant, Mickey Mice, etc.).

V.P. ADMINISTRATION - JOHN BYRNE

The V.P. admin's job is very demanding because it involves dealing with the Store's and the Society's insurance policies, class elections, the constitution and all other administrative hassles that crop up. John is a third year Eng Sci and I know that he is very competent at clearing up such headaches. As this year's Communication Committee Chairman he is a member of both the Eng Soc Council and the Eng Soc



Standing: Diane Kapica, John Byrne, Dave Neale, Spiros Pantziris.

Seated: Dave Legresley

Executive. A sample of his abilities were displayed recently when he did an extensive study of printing costs for the various Society publications. I think John would do a very thorough job as V.P. Admin. and I feel that his experience would be very beneficial to next year's Eng Soc Executive.

V.P. ACTIVITIES - DAVE NEALE

Dave has been a member of this year's Eng Soc Executive as the Employment Committee Chairman and he has been active in all areas of "SKULE" life. Some of these events included orientation, pubs, slave auctions, chariot race, etc. A large part of the V.P. Activities job is to organize orientation and, as I did it last

year, I know that no one will do a better job than Dave. He helped out tremendously last year and this year he is hoping to give the Flrosh an even bigger welcoming to UofT Engineering. With more pubs and a stronger BFC we hope that everyone will get involved and have a good time next year.

TREASURER - SPIROS PANTZIRIS

Spiros will do an excellent job as treasurer for several reasons. As a third year Industrial he has taken several accounting and management courses and during the summer he worked in offices where he obtained some industrial accounting experience. Add to this Spiros' desire to put some time into the position and I feel that next year's finances will be

in very good hands. As treasurer Spiros would like to keep the books up to date (for a change) so that we will know exactly how much money is available for every event.

SECRETARY — DIANE KAPICA

Diane, a second year Industrial, is running on the ticket for secretary of next year's council. She was a class rep on the Eng Soc Council in her first year, and she is a Faculty Council rep this year. Diane has been the secretary for the student council at her high school, and was secretary-treasurer for the high school athletic council. I feel that this experience, plus her willingness to work qualify Diane for the position of secretary on next year's Eng Soc Executive.

Micromputers: The building blocks

Continued from page 1

you learn to look for 8xxx for an 8080 part, 68xx for a 6800 part and so on, but beyond that the only way to find out what a part does is to look in the catalog. On the other hand,

since you're designing by function anyway, you don't have to worry about the actual number until you're ready to order.

The acronyms for different IC types are almost as confusing as the numbering systems. For our purposes, the

actual details aren't important; it's enough to know that 'CMOS' runs on much less power than 'NMOS', and LS TTL is what you usually use for additional logic.

All that's left in the system design is connecting the parts together and making them work. All microprocessor parts are more-or-less directly compatible, and from a system viewpoint a good rule of thumb is that for small systems (15 parts or less) anything can be hooked up to anything else. (See 'Interfacing Logic Types').

The microprocessor 'talks' with the peripherals along a set of eight bidirectional lines called the 'data bus'. The processor controls the bus, and prevents conflicting signals by electrically disconnecting all but one peripheral at any one time.

Other control lines show whether the processor wants to read (data or status) or write (data or commands), and when everything's ready (see 'Converting Control Signals').

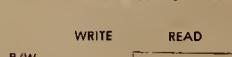
Now that we've got the building blocks, we're ready to start designing real systems. In the final installment next issue we'll take a look at the design process and some practical considerations.

Converting Control Signals

Unfortunately, microprocessor manufacturers have adopted two distinct approaches to generating the read/write control signals. One group, headed by the 8080, uses separate READ (RD) and WRITE (WR) lines which are active only during the respective operations. The other, headed by the 6800, uses one READ/WRITE (R/W) status line and a separate ENABLE (EN) signal for the timing (see diagram).



Timing for 8080 type systems



Timing for 6800 type systems

one of two lines depending on the state of R/W.

It's a bit more difficult going the other way since most 6800 parts require about 150 nanoseconds of setup time on the R/W line before the EN pulse starts. This means you need to know whether the processor is going to read or write before RD or WR is output.

Some processors have an advanced status output line (like 'S1' on the 8080); on others it can be latched from the data bus early in the instruction cycle (like the 8080); and others don't give it at all (like the 1802). However, the address lines are stable long before any read/write operations, and it's easy enough to split the peripheral address into read and write locations, so that one of the address lines becomes R/W.

The table shows the timing characteristics for some of the common microprocessors and peripherals.

Processor	RD	WR	EN	R/W
8080	✓	✓		1 2 A
8085	✓	✓		1 S1,A
NSC800	✓	✓		1 S1,A
Z80	✓	✓		1 A
1802	✓	✓		1 A
SC/MP	✓	✓		1 3 A
6800	4	4		—
6801	4	4		—
6809	4	4		—
6502	4	4		—

- 1: RD OR WR
- 2: Latch D1 = WO
- 3: Latch D4 = R Flag
- 4: Use EN to gate R/W
- A: Use address line

Interfacing Logic Types

For discrete logic (gates and so on),

you normally use LS (for Low power Shottky) TTL which has about a third the loading but the same speed. Slower systems, especially all CMOS ones, can use CMOS gates to good advantage instead.

The table shows rough guidelines for interfacing the various logic families to one another. In any case, though, it's wise to check the respective data sheets to make sure the driver and receiver parameters are compatible and have enough safety margin to ensure that they'll work properly.

FROM	TO	NMOS	CMOS	micro	4000	74C	74xx	74LSxx
NMOS	✓	✓	✓	✓	✓	✓	✓	✓
CMOS	✓	✓	✓	✓	✓	✓	✓	✓
micro	✓	✓	✓	✓	✓	✓	✓	✓
4000	✓	✓	✓	✓	✓	✓	✓	✓
74C	✓	✓	✓	✓	✓	✓	✓	✓
TTL	74xx	✓	✓	✓	✓	✓	✓	✓
74LSxx	✓	✓	✓	✓	✓	✓	✓	✓

A: use pullup resistor
B: probably OK
X: use buffer

Most microprocessors are either NMOS (N-channel Metal Oxide Semiconductor) or CMOS (Complementary Symmetry MOS) is gaining popularity since it uses less power, has a wider supply voltage range, and a high input impedance. However, most are still NMOS which is somewhat cheaper, and often faster.

Regardless, both types are generally designed to be TTL (Transistor-Transistor Logic) compatible, which means they can drive the standard TTL load.

Logic '1': 2V at 400 microAmps
Logic '0': 0.8V at 1.6mA

NMOS has a typical input impedance of 10 microA, and CMOS as little as 0.1 microA. This would seem to imply that a single TTL compatible microprocessor could have up to 40 NMOS or 4000 CMOS peripherals. However, each input also has of the order of 10 pF of capacitance due to packaging, construction and so on. Since the driver must charge and discharge this capacitor for each state change, typical systems can only run at full speed for loads up to 150 pF, or 10 to 15 peripherals. If more are needed then current boosting buffer amplifiers must be used.

SOCIETY HOPEFULS



Bob Moult: Pictured defending the honour of engineers.

PRESIDENT - BOB MOULT

The Engineering Society is supposed to be run for your benefit. I'm running for the position of President because I believe it needs accessibility, spirit and experience to be done properly.

My name is Bob Moult and I'm in 3rd year Electrical. I became Toike editor last year because I didn't believe you were satisfied with the paper. Since you pay for it, the Toike is responsible to you. I think you'll agree we've made it more popular! Not only that, but we've changed it into a money making proposition.

This year I'm running for President because I don't

believe this year's officers have fulfilled their responsibility to you. The president must make himself available to the students so you know who he is and can come to him with your problems or suggestions, whether they're about the Society or just a case of zero motivation. This summer I'll be working at the university so I'll be able to take an active part in organizing and running things even before the Skule year starts.

An effective president must be able to follow up as well as delegate authority. I intend to increase the strength of the course clubs and will leave the

running of the Council to the Speaker where it belongs. This year the BFC was given \$350. What did they do with it? The bricking in of SAC was done by a group of spirited Flrosh and paid for by the Toike. Why?

As Toike editor I was in on the organization of orientation and many other Skule events as well as running as \$10,000 paper. I've been on committees, gone to meetings, and done my best to make sure you got the best deal. I know how the Society works, and I know how to make it work better.

Check the record and vote Thursday or Friday.

SECRETARY - JOHN VOSS

I am seeking the position of Secretary of the Engineering Society for two reasons. I know what has to be done, and I know I can help do it. I have qualifications which I feel will be valuable to next year's executive.

Next year, the Engineering Society will face a number of serious challenges, not the least of which involves Skule Spirit. For some time, Eng. Soc. has been stagnating and, as a result, Skule Spirit has suffered. Only 18% of engineers cared enough to vote in the recent Fees Referendum, and lately Council meetings are having

difficulty making quorum. There are some early signs of improvements-this year we are enjoying elections rather than acclamations-but it will be the responsibility of next year's executive to foster and rejuvenate this spirit. We'll need an executive of responsible, capable, and dedicated people.

Why am I qualified? I am the editor of Skule 8TO, the Engineering Yearbook. I know what Skule Spirit is because I've spent the year recording it. I have had the opportunity of working with this year's executive and I know how the

Engineering Society and Council operate. I have also worked with many of the candidates for next year's executive and I feel I would be capable of co-operating effectively with them on executive.

In short, there is a job to do. My experience as Skule editor has shown me to be responsible and capable. I have valuable knowledge of how the Society operates, and of how to work with the people who will be next year's President and Vice-Presidents. I want to put this experience to work.



John Voss hopes to bring the experience he has gained as yearbook editor to next year's Executive.



Simon Monk is a frequent figure at all Skule functions, whether with the Brad or not. Next year he would like to take a bigger part in organizing skule activities.

VP: ADMIN-SIMON MONK

The Vice President: Administration is responsible for overseeing all financial and administrative affairs of the Society. In other words, he's the budget chief.

I have been involved in Eng. Soc. for two years as co-leader of the Lady Godiva Memorial Band, kibitzing with Bob Moult and the Toike staff and generally spending a lot of time on the third floor of the Metro Library Building. Next year you'll be paying \$16 for your Society and I want to make sure that your money will be put to best use.

If you've read this far then you are the kind of person we need; someone who wants to get involved in your Eng. Soc. My platform is just that: get involved, find out what's going on—pub nights, frosh orientation, intramural and inter-faculty sports, Skule Night, Toike, chariot race,...the list of activities goes on and on. Whatever you're interested in, we've got it and if we don't, tell us about it and let's get it going.

Let's put the spirit back in Skule!

HELP!

The Engineering Society is in dire need of volunteers to man the polling stations during the upcoming election Thursday and Friday, March 6-7. We would like to have three polling stations running throughout both these days. If you have a few spare hours and could help please come up to the Eng Soc offices and tell Ella.

VOTE
Thursday
Friday

Letters to the Editor

I am compelled to write about Mr. Vogt's article in the February 26, 1980 edition of "The Cannon", because I believe his ideas deserve, if not demand, a response.

I do not believe that Mr. Vogt and I agree on the aims of an engineering education, and if his views are supported by the professors of this university then I would be very surprised indeed. I get the feeling, both from Mr. Vogt's article and from many students' attitudes, that a B.A.Sc. degree is seen merely as a prerequisite for a job. A degree is not a stepping stone to a job, nor can one's education as an engineer be considered complete once a degree is conferred. How can anyone learn all that is

necessary in a mere four years. So what then is the point of a degree? I believe that the "culture shock" that Mr. Vogt mentions can be minimized if one realizes that job preparation is not the purpose of a university education. Instead, I believe a university education should not only allow one to learn a set of basic principles, but should also allow one to learn a way of learning and applying new information throughout one's life and professional career.

I will not answer Mr. Vogt's questions because I do not consider them necessarily the right questions to ask. It is good for students to ask questions though, but they should be willing to also provide answers. Students should not be expected to let "the system," as Mr. Vogt calls it, lead them by the hand through their university life and into a comfortable job. Instead, in the process of earning a degree, a student should learn the self discipline necessary if one is to be a professional engineer.

Rob Anderson

the Cannon

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Submissions are welcome; please send the deadline for articles and announcements for the upcoming Tuesday's issue is Friday at five. The editors reserve the right to edit letters.

THE CANNON is a publication of the University of Toronto Engineering Society. It is published to announce Eng Soc events, discuss Faculty and educational matters, present technical and University news and to be an open forum for the opinions and interests of members of the Faculty. All those who would like to help with THE CANNON are most welcome.



TINY TOIKE PAGE

THE ENGINEERING ATHLETIC ASSOCIATION
PRESENTS
FOR THE FREE ENTERTAINMENT
OF ALL ENGINEERS AND THEIR DATES

THE ANNUAL



-DANCE

TO BE HELD IN THE COMMONWEALTH BALLROOM
OF THE HOLIDAY INN - DOWNTOWN
(CHESTNUT AND DUNDAS STREETS)

SATURDAY, MARCH 8th, 1980

7:00 P.M. - COCKTAIL RECEPTION
8:00 P.M. - AWARDS PRESENTATION
9:00 P.M. - 1:00 A.M. DANCING

CASH BAR ADMISSION IS FREE - TICKETS AT ATHLETIC STORES
OR THE ENGINEERING STORES

COMPLIMENTARY BUFFET SEMI-FORMAL

First Meeting of the new
Student Council
March 18, 1980
GB. 220
5 p.m.
All Students
are Welcome to Attend

**ANNUAL ELECTRICAL CLUB
DINNER**



Get Your Tickets Soon.
Available from your
class rep, or Laura.

March 27, 1980
6:00 p.m.
Sai Woo Restaurant and Tavern
(Dundas St., West of Bay)
**Ticket \$8 per person
(includes wine)**

GRAD BALL 8T0

Saturday, March 15th

at the

Hotel Toronto

Ticket includes Dinner, Dancing to
Nova Sounds and Complimentary
Club Parties, all nite long.

Ask your Club Chairperson
for Details!



\$60/couple.

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